Vegetation Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #6: Subplot Sampling (Species Cover, Tree Seedlings, and Saplings [<15 cm DBH])

Version 1.00

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedure for establishing the nested subplots within the four intensive modules and for recording presence absence and cover percentage of species. Seedlings and small trees are measured at the 10 m^2 and 100 m^2 subplot, depending on the height and the diameter at breast height (DBH).

Subplot Setup

This procedure assumes plots have been set up following the process outlined in SOP #4: Site Locations, Set-up, Monumenting, and Description.

1. For consistency, 10 x 10 m intensive modules with subplots should be completed in a specific order: 2, 3, 8, and 9 (Figures 1 and 2). ***Be careful not to trample the subplots***. When traveling between intensive modules (or any module within the site), walk along the module boundaries, or off-site, when possible.
2. Using a Biltmore stick, layout the 1 m x 1 m subplot. Place a pin flag at the inside corner of the 1 m^2 subplot. Use a Biltmore stick to delineate one of the sides without a tape, and a meter stick or tape for the other.
3. To set up the 10 m^2 subplot, using meter tapes, measure 3.16 m in each direction, from the corner stake, forming a 90 degree angle. Mark with a pin flag. Extend each tape 90 degrees toward the plot center and mark the location where the two tapes intersect at 3.16 m; place a pin flag to establish the inner corner of the 10 m^2 subplot.
4. Use the diagonal measurement to make sure that subplots are square and improve the chances that sampling is done in the same place in subsequent revisits.
5. Repeat the above procedure for the other three intensive modules after recording species cover and tree density measurements.

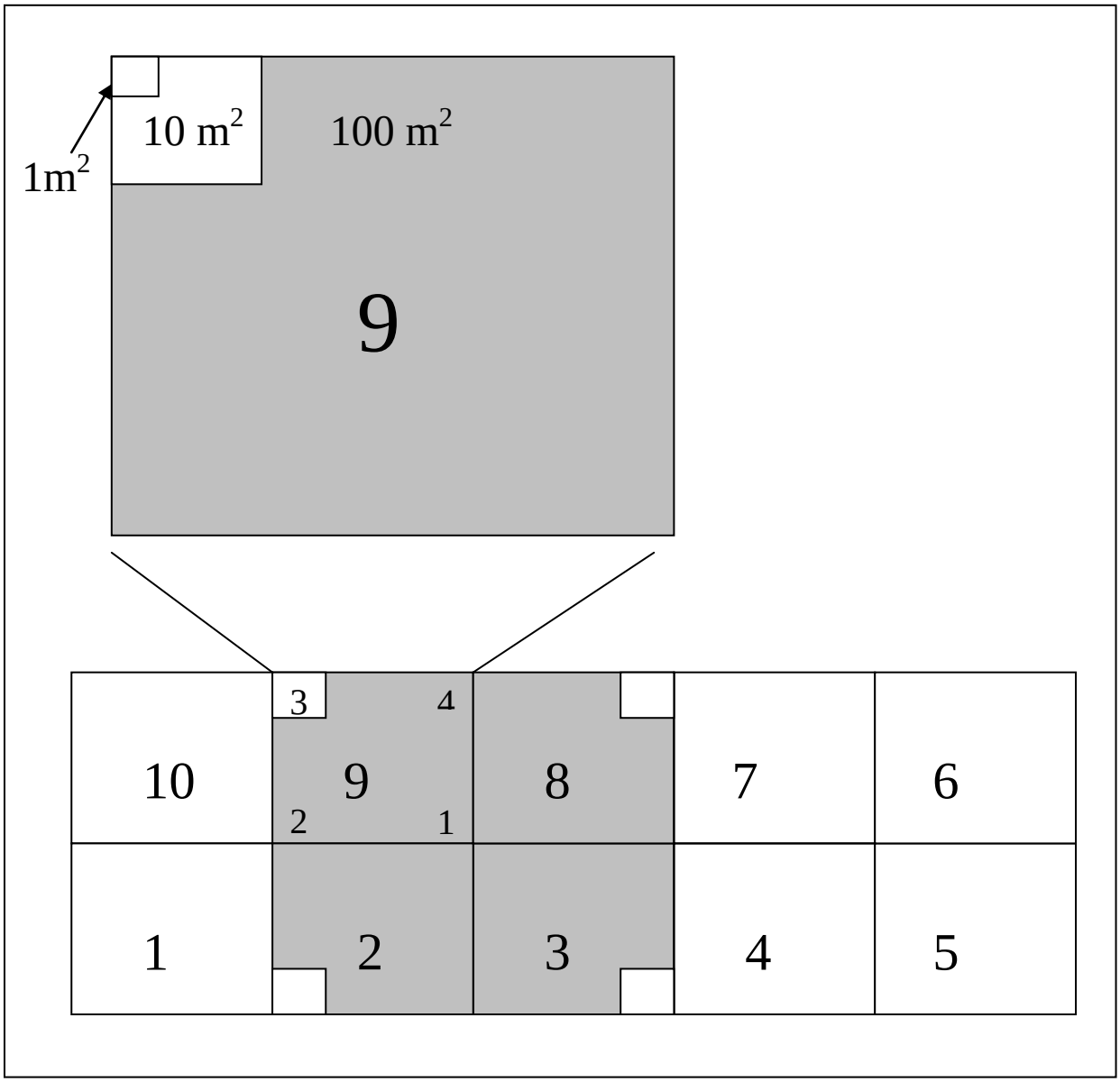

Figure 1. Arrangement of intensive modules and subplots. Location of nested subplots within the 0.1 ha long-term non-riparian vegetation monitoring plot. Nested plots, 1 m^2, 10 m^2, and the 100 m^2 modules (in gray) are sampled. Module corners are numbered as shown for module 9.

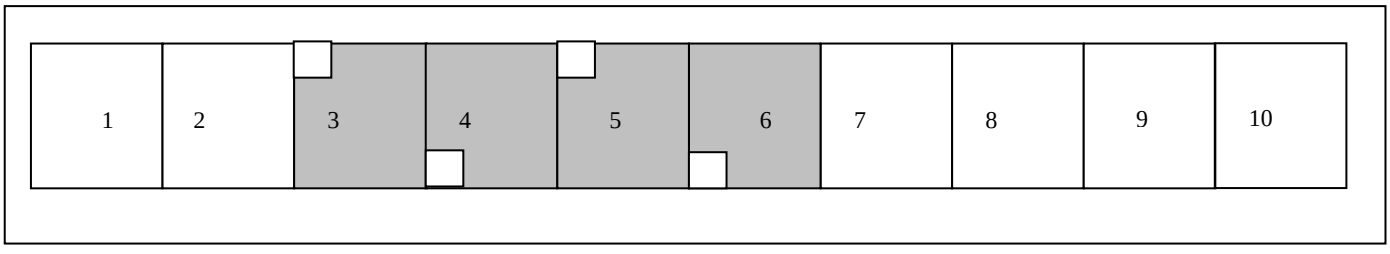

Figure 2. Location of riparian modules.

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Species Cover

The nested subplot sampling inventories all vascular plant species on the main 0.1 ha plot to estimate their percent cover in four height strata. This sampling is mostly done in the four intensive modules (2, 3, 8, and 9 for non-riparian plots and 3, 4, 5, and 6 for riparian plots; see Figures 1 and 2, respectively). After sampling the four intensive modules, the entire 0.1 ha site is surveyed for species that did not occur in the module subplots.

1. Sample progressively from smallest to largest subplot. Species occurrence is recorded in three nested subplots: 1 m^2, 10 m^2, and the 100 m^2 module (Figure 1). On the subplot sampling card (Appendix 1) for nested plot sampling, the first occurrence of a species is noted in the column labeled subplot, by recording a 1, 10, or 100 according to the smallest size subplot in which the species in encountered.
2. Percent cover is estimated to be Trace, <1%, or to the nearest 1% if ≥1 for each species within the 100 m^2 intensive modules. Cover is estimated for individuals belonging to four height strata: S1 = (<0.75 m height), S2 = (0.75-2.5 m), S3 = (2.6-5 m), and S4 = (>5 m). The height strata of a species is determined by the maximum height of the individual(s) (e.g., *Abies concolor* [white fir] could belong to all four strata if seedlings (<0.75 m), saplings (0.75-2.5 m) poles (2.6-5 m) and mature trees (>5 m) were present in the 100 m^2 module). Species cover estimates are entered in the corresponding columns labeled S1, S2, S3, and S4 on the subplots datasheet. Individual plants rooted outside the plot but overhanging a module contribute to species cover (and are recorded as O in the column labeled subplot. Percent cover of rock (>1.5 cm diameter), bare soil (including rock <1.5 cm diameter), water, bryophytes, fine wood (0-7 cm) and litter, coarse woody debris, and shrub height (see below) are also recorded for the 100 m^2 plot.
3. After all four intensive plots have been sampled, subplot sampling ends when there are no more unrecorded species in the module, or in dense vegetation after 5-10 minutes has elapsed without the discovery of a new species.
4. Then, the other six modules are searched for species that did not occur in the intensive modules. Record these as **NEW** species across the entire 0.1ha plot and record the module numbers on the datasheet. To maximize efficiency, this step is best done by the person measuring the tree DBH during overstory sampling, or the person who measures overstory cover with the densiometer.

Training in Cover Estimates

Crew members will be trained in how to estimate foliar cover; measure tree DBHs; and sample down wood, litter, and duff in the field during the setup and measurement of two to three mock plots (SOP #1: Observer Training). Consistent cover estimates are important for modeling and for tracking changes in cover over time. However, obtaining consistent estimates among observers is notoriously difficult. The following guidelines will be followed to help improve consistency. Figures 3 and 4 are guides to help in the consistent estimation of plant cover.

1. Discuss cover estimation in a group setting, allowing for consideration of each other's estimates. With practice and discussion, foliar cover estimates by observers should begin to converge.
2. Practice estimating cover for different life forms, such as forbs, grasses, and shrubs.

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3. Throughout the sampling season, review foliar cover estimation. Periodically compare observer's cover estimates.
4. Ensure good communication among the crew about observer patterns of cover estimation.
5. As vegetation dies back, discuss estimation standards for estimating foliar cover of senescing vegetation.

There are numerous ways to estimate cover *of* a species on a plot. Begin by choosing one *of* the dominant species on the plot. Do this species very carefully using one or more *of* the following methods:

1. Quickly estimate whether the species covers more or less than half *of* the plot, then more or less than $^1/_4$ or $^3/_4$ of the plot:

- if the species is greater than 75%, use methods 5, 6;
- if the species is 25-75%, use methods 3, 4, 5, 6;
- if the species is less than 25%, use methods 2, 3, 4.

2. Measure or estimate areas that are 1% and 10% *of* the plot. Ten percent *of* a 0.1 ha (1000 m^2) plot is 100 m^2, one 10 m x 10 m module; 1% *of* a 0.1 ha (1000 m^2) plot is 10 m^2 (3.16 m x 3.16 m). For species with low cover in the plot, it is often useful to try to mentally fill a 1% area (you have set up a 1 x1 m subplot for reference). If you fill the 1% area with plants and still have plants left over, fill another. This would give you 2%. Or if there are still some plants left over, fill another, and so on.

3. Measure the actual area covered by individual plants or clumps. This works well for large or clumpy plants such as vine maple, ocean spray, or trees. For example, given a large clump *of* vine maple, measure a typical radius *of* the clump and convert to area. If the radius was 3.5 m (3.5 x 3.5 x pi = 38.5 m^2), then that clump would be (38.5/100), 38.5% *of* the plot.

4. Measure or estimate the size *of* a typical individual *of* a species and then count the individuals *of* that species. This works well for small to medium-sized plants such as sword fern or bunchgrass. If the typical sword fern in a module was .6 m radius, or ~1%, and there were 24 plants, the cover for sword fern would be 24%.

5. Estimate the area not covered by a species. Use this method when a species has more than 75% cover. Use methods 2, 3, or 4, but apply them to areas not covered by a species. This often works well for dense species!

6. Divide the plot or module into quarters or halves if the species is very unevenly distributed or if the plot is large. If you divide a plot into quarters, estimate each quarter separately, then average the four quarters together. If most of the plants of one species fall in one of the quarters, mentally try to fill in the holes with plants from the other quarters.

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7. Check your cover estimates by:
    - comparing each species to one that you are relatively certain about;
    - comparing estimates on the same species done by different methods; and
    - comparing to someone else's estimate.

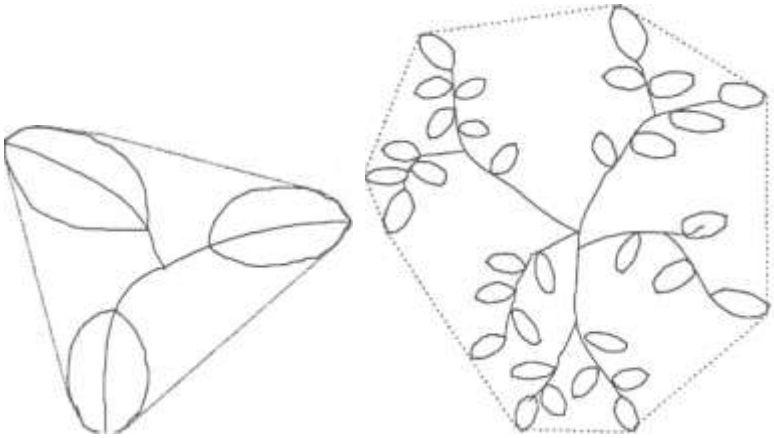

Figure 3. Plant cover is defined as the area of a polygon formed by connecting the outermost leaves and stems of a plant. In this drawing, the polygon is shown as the light dotted line connecting the outer parts of the plant.

It is the Project Lead's responsibility to test each member of the crew on their ability to measure foliar cover.

See SOP # 14: Collecting and Identifying Unknown Plants for information on dealing with unknown species.

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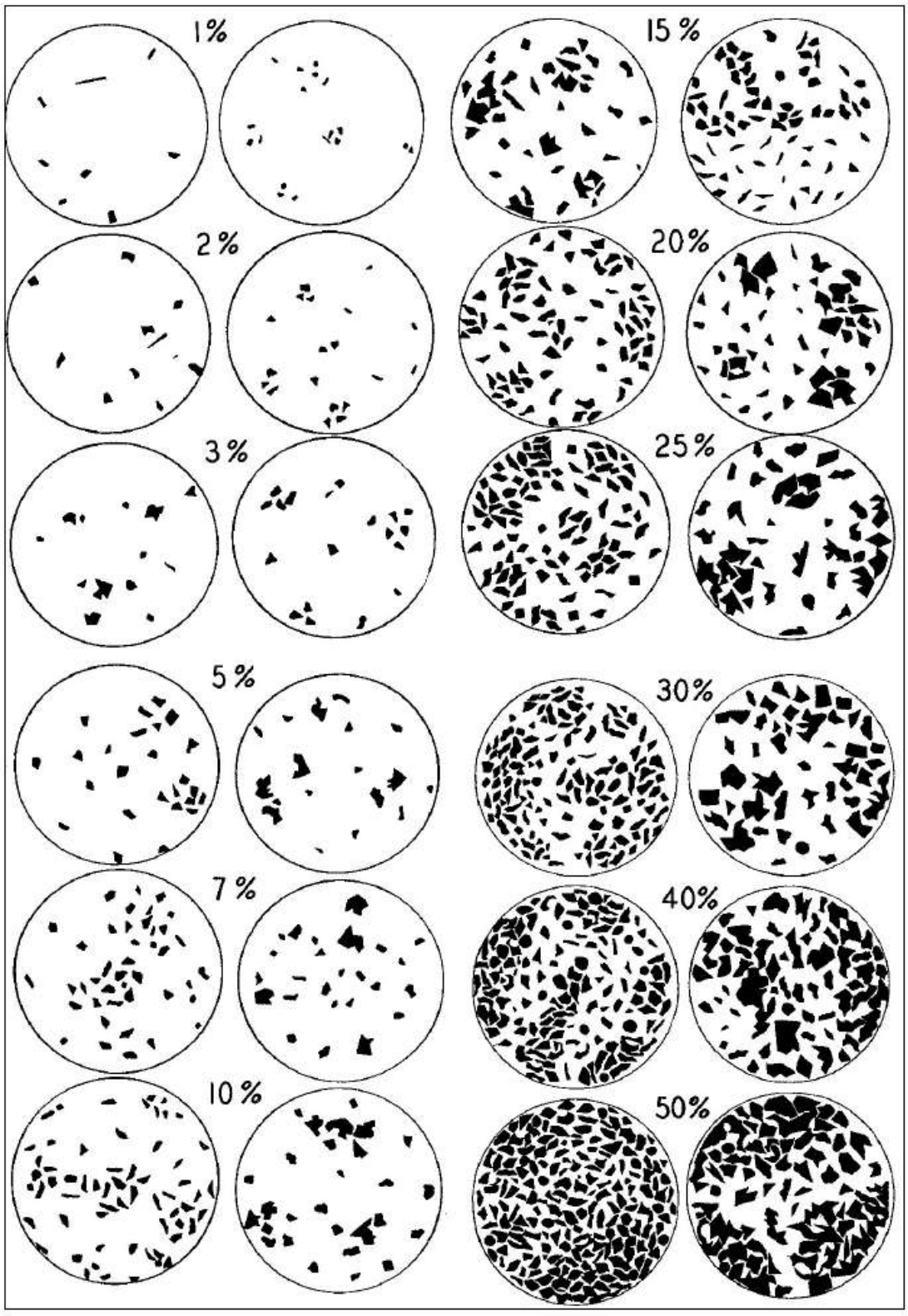

Figure 4. Reference scatterplots for cover estimates. From the 2006 Forest and Inventory Analysis Protocol.

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Shrub Height Measurement

The average height of shrub cover is measured in each quadrant for each intensive module.

1) Visually divide an intensive module into four quadrants.
2) Measure the average shrub height using a meter stick or tape. This measurement does not include trees. A species list for each park indicates which species are shrubs.
3) Record this measurement for each of the quadrants individually on the datasheet (Appendix 1).
4) Repeat for the other three intensive modules.

Trees <15 cm DBH

Appendix 2 shows the datasheet for recording tree seedlings according to the following methods:

1. Tree seedlings by species (refer to the park species list) ≤15 cm tall are counted in the four 10 m^2 (3.16 m x 3.16 m) subplots located in the corner of the four intensive modules, by live vs. dead. Whitebark pine seedlings, if encountered, are counted throughout the entire 0.1 ha plot area. Dead seedlings are included but the identification may have to be listed as unknown conifer or hardwood since they may be impossible to identify to species.
2. Tree saplings by species from >15 cm tall to <2.54 cm DBH are inventoried in the four 10 m^2 (3.16 m x 3.16 m) subplots, by live vs. dead. Whitebark pine saplings, if encountered, are counted throughout the entire 0.1 ha plot area. Dead saplings are included but the identification may have to be listed as unknown conifer or hardwood since they may be impossible to identify to species.
3. Tree saplings by species from ≥2.54 cm DBH to 5 cm DBH are inventoried in the four intensive 100 m^2 (10 m x 10 m) modules. The number of alive and dead individuals of each species is counted. Whitebark pine, if encountered, is also counted in the remaining modules to provide a total for the entire 0.1 ha plot area.
4. Trees by species from >5-10 cm DBH are inventoried in the four intensive 100 m^2 (10 m x 10 m) modules. The number of alive and dead individuals of each species is counted. Whitebark pine, if encountered, is also counted in the remaining modules to provide a total for the entire 0.1 ha plot area.
5. Trees by species from >10-<15 cm DBH are inventoried in the four intensive 100 m^2 (10 m x 10 m) modules. The number of alive and dead individuals of each species is counted. Whitebark pine, if encountered, is also counted in the remaining modules to provide a total for the entire 0.1 ha plot area.

Subplot Sampling Card ___#of___

Park, Plot#, Module#	**Date**		**Crew**			**Start Time** **End Time**
	module	Q1	Q2	Q3	Q4	Notes
Rock						
Bare soil						
Bryophytes						
Coarse wood						
Fine wood and litter						
Water						
Shrub height						
Species/Species code	Subplot	S1	S2	S3	S4	

Appendix 1. Subplot sampling card for recording percent cover by vegetation stratum.

Trees Count <15cm DBH Card __#of__											
Park and Plot#				**Date**			**Crew**			**Time Begin** **Time End**	
		<15cm tall 10m² Subplot (seedling)		**15cm-2.54 cm dbh 10m² Subplot (sapling)**		**2.54 cm dbh-5cm DBH 100m² Subplot (pole)**		**>5cm-10cm DBH 100m² Subplot (pole)**		**>10cm-15cm DBH 100m² Subplot (pole)**	
Species Code	**Module**	**Count Alive**	**Count Dead**	**Count Alive**	**Count Dead**	**Count Alive**	**Count Dead**	**Count Alive**	**Count Dead**	**Count Alive**	**Count Dead**
PIAL	ALL										

Appendix 2. Datasheet for recording tree seedling data.